

NEW TECHNIQUES FOR NANOANALYSIS AND NANOGEOLOGY

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The Local Electrode Atom Probe (LEAP) is a new analytical technique that is capable of performing *three-dimensional nanoanalysis with near atomic spatial resolution and high mass resolution*. The LEAP is based on the Field Ion Microscope (FIM) and utilizes a rapidly pulsed, localized electric field to evaporate a needle-shaped specimen one atom at a time. The ions are accelerated through an aperture in an accelerating microelectrode. A two-dimensional detector, such as a delay-line detector, collects the ions with single atom sensitivity. Since the LEAP is capable of identifying each atom, the accumulated data allows the three-dimensional reconstruction of the sample's structure and composition at the nanometer scale.

Focused ion beam secondary ion mass spectroscopy (FIB-SIMS) is a relatively new analytical technique based upon the Focused Ion Beam (FIB) microscope which uses a finely focused beam of gallium ions from a liquid metal source to sputter the sample. The sputtered ions are collected by a Secondary Ion Mass Spectrometer (SIMS) resulting in elemental maps as a function of depth with resolution approaching 20 nm. Focused ion beam secondary ion mass spectroscopy has yet to be widely applied to geological specimens. Compositional changes and phase differences are measurable on small scales with FIB-SIMS, and difficulties due to differential sputtering in conventional SIMS analyses are overcome by sampling at specific depths rather than continuously profiling the sample. The FIB-SIMS provides a bridge between Energy Dispersive Spectroscopy (EDS) in the Scanning Electron Microscope (SEM) and facilitates the fabrication of samples for LEAP, Transmission Electron Microscopy (TEM) and Electron Energy Loss Spectroscopy (EELS).

Initial results of FIM and FIB-SIMS analyses of a metamorphic magnetite sample containing disk-shaped exsolution lamellae approximately 40 nm in diameter, 1-3 nm thick and about 10^4 platelets/ μm^3 will be discussed. The FIB-SIMS cross-sectioning and imaging of a geomicrobiological sample will also be presented.